

# **EXHIBIT 3**

**IN THE UNITED STATES DISTRICT COURT  
FOR THE SOUTHERN DISTRICT OF NEW YORK**

CARNEGIE INSTITUTION OF  
WASHINGTON and M7D CORPORATION,

*Plaintiffs,*

v.

FENIX DIAMONDS LLC,

*Defendant.*

FENIX DIAMONDS LLC,

*Counterclaim-Plaintiff,*

v.

CARNEGIE INSTITUTION OF  
WASHINGTON and M7D CORPORATION,

*Counterclaim-Defendants.*

Civil Action No. 1:20-cv-0200 (JSR)

Honorable Jed S. Rakoff

**FENIX’S FIRST SUPPLEMENTED PRELIMINARY INVALIDITY CONTENTIONS  
UNDER LOCAL PATENT RULE 7**

Pursuant to Local Patent Rule 7, Defendant Fenix Diamonds LLC (“Fenix”) hereby serves its First Supplemented Preliminary Invalidity Contentions (“Contentions”) concerning asserted claims 1, 6, 7, 11, 12 and 16 of the U.S. Patent No. 6,858,078 (“the ’078 patent”) and claims 1 and 2 of U.S. Patent No. RE41,189 (“the ’189 patent”) (collectively, the “Asserted Claims”).

In these Contentions, with respect to each of the Asserted Claims, Fenix: (i) identifies each currently known item of prior art that anticipates or renders obvious each Asserted Claim; (ii) submits charts for illustrative prior art references identifying where each limitation of each Asserted Claim is disclosed or rendered obvious by the prior art; (iii) identifies the grounds for invalidating Asserted Claims under 35 U.S.C. § 101 for failure to claim patent eligible subject matter; and (iv) identifies the grounds for invalidating Asserted Claims based on indefiniteness, enablement, and/or written description under 35 U.S.C. § 112.

### **III. THE ASSERTED CLAIMS ARE INVALID**

#### **A. The Asserted Claims of the '078 and '189 Patents are invalid under §§ 102 and 103 for being anticipated by, and obvious over, the prior art.**

Subject to Fenix's reservation of rights above and pursuant to Local Patent Rule 7, Fenix identifies the following items of prior art that anticipates or renders obvious one or more of the Asserted Claims. The patents, patent applications, publications, and products identified herein as prior art are also relevant for their showing of the state of the art and reasons and motivations for making improvements, additions, and combinations.

Discovery is ongoing and Fenix's prior art investigation is therefore not yet complete. Fenix reserves the right to present additional items of prior art located during the course of discovery or further investigation.

References relied on by Fenix to support anticipation, obviousness, and other grounds of invalidity of the one or more of the Asserted Claims are set forth in Exhibit A. The naming conventions set out in Exhibit A are globally observed.

Claim charts mapping exemplary disclosures from each of the above-identified prior art references are attached hereto as Exhibits B (including Exhibits B.1 and B.2) and C (including Exhibits C.1, and C.2). In these claim charts, exemplary of the references are cited both to demonstrate anticipation through explicit disclosure and how that explicit disclosure of the reference would render the claim obvious alone or in combination, for example, with any of the other cited references. The cited portions of the references are not intended to be exhaustive. They are merely exemplary as to the teachings of the applicable references.

Specifically, Exhibit B.1 demonstrates both (i) how prior art anticipates the Asserted '078 Claims under § 102 and (ii) how the same prior art can be applied as a primary reference to invalidate the Asserted '078 Claims under § 103, alone, or in combination with one or more

**B. The Asserted '078 Claims are invalid under §§ 101 and 112.**

**1. The Asserted '078 Claims are invalid under § 101 for being patent ineligible.**

The Asserted '078 Claims are patent ineligible, and thus invalid, under 35 U.S.C. § 101. *See American Axle v. Neapco Holdings* (Fed. Cir. 2019).<sup>10</sup> In that case, the patentee recited a combination of mechanical structure and a desired result.<sup>11</sup> The Federal Circuit dismissed the mechanical structure as “conventional pre- and post-solution activity.”<sup>12</sup> The Federal Circuit classified the recited desired result (e.g., “[a] liner being tuned to within about  $\pm 20\%$  of a... frequency of [a] shaft assembly”) as being directed to a “law of nature.”<sup>13</sup> As a result, the Federal Circuit held that the subject claims were patent ineligible and thus invalid.

The similarities between *American Axle* and the '078 Patent are striking:

*First Similarity:* Both the claims considered in *American Axle* and the Asserted '078 Claims consist entirely of (i) a functionally recited desired result and (ii) collateral prior art structure for tying the desired result to a particular context.

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<sup>10</sup> *American Axle v. Neapco Holdings*, 939 F.3d 1355 (Fed. Cir. 2019). *See, e.g., American Axle* at 1361 (“There is no legal principle that a claim to a method of manufacturing cannot be directed to a natural law, nor are there any cases saying so. The [patent found to be patent ineligible] discloses a method of manufacturing a driveline propshaft containing a liner designed such that its frequencies attenuate two modes of vibration simultaneously.”).

<sup>11</sup> *American Axle* at 1366 (“The claims here simply instruct the reader to tune the liner—a process that, as explained above, merely amounts to an application of a natural law... to a complex system without the benefit of instructions on how to do so.”). *American Axle* at 1377 (“The focus of the claimed advance here is simply the concept of achieving that [desired] result, by whatever structures or steps happen to work.”).

<sup>12</sup> *American Axle* at 1368.

<sup>13</sup> *American Axle* at 1361 (“The claims are directed to tuning liners... to match the [claimed] frequency or frequencies.”). *American Axle* at 1362 (“[T]he claims’ instruction to tune a liner essentially amounts to the sort of directed prohibited by the Supreme Court in *Mayo*—i.e., simply stating a law of nature while adding the words ‘apply it.’”). Internal quotation marks omitted.

In *American Axle*, the desired result included “positioning” a liner within a shaft member to reduce “shell mode vibrations” by at least 2% and “tun[ing]” the liner “to within about  $\pm 20\%$  of a bending mode natural frequency of [a] shaft assembly as installed in [a] driveline system.”<sup>14</sup>

The collateral prior art structure included “a shaft assembly of a driveline system... the shaft assembly being adapted to transmit torque between [a] first driveline component and [a] second driveline component”, “a hollow shaft member”, “at least one liner [positioned] within the shaft member such that the at least one liner is configured to damp... vibrations in the shaft member.”<sup>15</sup>

In the Asserted '078 Claims, the desired result is “controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than  $20^{\circ}\text{C}$ .”<sup>16</sup>

The collateral prior art structure<sup>17</sup> includes “growing single-crystal diamond by microwave plasma chemical vapor deposition... [above a recited pressure in claim 1, within a pressure range in claims 6 and 16, within a temperature range in claims 7 and 12, and within a range growth rates in claim 11]. *See, e.g.*, Exhibit B (i.e., Exhibits B.1 and B.2)

*Second Similarity:* Both the claims considered in *American Axle* and the Asserted '078 Claims fail to recite a mechanism for producing the desired result. In each case, “[t]he focus of the

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<sup>14</sup> *American Axle* at 1359.

<sup>15</sup> *American Axle* at 1359.

<sup>16</sup> *See, e.g.*, claim limitations 1.[A] and 12.[A].

<sup>17</sup> Unlike the case considered in *American Axle*, every limitation of the Asserted '078 Claims, including those directed to the sub- $20^{\circ}\text{C}$  temperature gradient, is disclosed in the prior art. *See, e.g.*, Exhibit B.

Step one “look[s] to the focus of the claimed advance.”<sup>42</sup> In the asserted claims, the focus of the claimed advance is “controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.” The claimed advance is a numerical restatement of the old and well-known natural phenomenon/law of nature in which “a uniform surface temperature is crucial for the deposition of diamond films with uniform properties.”<sup>43</sup> Put differently, the plaintiffs have rephrased a well-known natural phenomenon/law of nature (i.e., uniform surface temperatures are useful to grow uniform diamonds) in terms of arbitrary numbers (i.e., all temperature gradients across the growth surface are less than 20° C).

At the same time, the structure described in the specification as achieving the law of nature/natural phenomenon (i.e., the holder making side-surface contact with the growing diamond) is absent from the claims. It is immaterial that the specification discloses a device allegedly capable of producing the claimed result because “features that are not claimed are irrelevant as to step 1 or step 2 of the *Mayo/Alice* [patent eligibility] analysis.”<sup>44</sup>

As a result, the Asserted '078 Claims are directed to the application of a natural law/phenomenon (i.e., uniform surface temperatures are required to grow uniform diamonds) in a particular context (i.e., diamond manufacturing). The claims do not teach how the target temperature gradients are measured or how, using that information, the temperature is tuned to a sub-20° C gradient. The claims simply instruct to “control[] the temperature” until the recited gradient occurs, “a process that...merely amounts to an application of a natural law... to a complex system without the benefit of instructions on how to do so.”<sup>45</sup>

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<sup>42</sup> *American Axle* at 1361.

<sup>43</sup> *Penn State* at 2.

<sup>44</sup> *American Axle* at 1363.

<sup>45</sup> *American Axle* at 1366.

**2. The Asserted '078 Claims are invalid under § 112, first paragraph, for being non-enabled and/or being unsupported by written description.**

For at least the following reasons, the Asserted '078 Claims are not enabled by virtue of the '078 Patent's failure to teach how to "make and use the full scope of the claimed invention without undue experimentation."

Referring to claims 1 and 12, the '078 Patent does not teach how to control the temperature of a growth surface such that all temperature gradients across the growth surface are less than 20° C without undue experimentation. The specification merely states that "[t]he main process controller 146 in FIG. 1 controls the temperatures of the growth surface such that all temperature gradients across the growth surface of the diamond are less than or equal to 20° C.

This does not enable one of ordinary skill to control all temperature gradients across the growth surface to the required degree. The '078 Patent does not enable one of ordinary skill in the art to directly control any growth surface temperature gradient. The control parameters described in the '078 Patent (e.g., microwave power, heat sink capacity, etc.) at best, relate to controlling global or average temperature of the growth surface, not any local gradient. *See, e.g.*, McGinnis at 139–152 (thermal spikes); Hemawan at 2790–2791 (hot spots); Liang 2013 at 197 (hot spots); Liang 2014 at 3235 ("a temperature distribution between 1000 and 1500 C could be obtained."); Nad 2015 at 26–33; Nad Dtn. at 200, 204, and 213 (hot spots).

The '078 Patent does not teach how to control a temperature gradient across the growth surface at any temperature, let alone the lower end of the claimed temperature gradient range (e.g., of 0, 0.001, 0.01, 0.1, 1, 5, or 10° C) without undue experimentation.<sup>48</sup> The '078 Patent does not

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<sup>48</sup> *See, e.g.*, Yan et al., "Very high growth rate chemical vapor deposition of single-crystal diamond", 99 Applied Physical Sciences 20, 12523–12525, 12523 (2002) ("Yan") ("The substrates required polished, smooth surfaces that were cleaned ultrasonically with acetone and... mounted on a molybdenum-substrate holder to ensure a uniform temperature.").

enable one of skill how to make and/or use any portion of the range of temperature gradients required by the Asserted '078 Claims, much less the entire range of recited temperature gradients. The Asserted Claims of the '078 Patent are not enabled and thus invalid under 35 U.S.C. § 112 because the equipment described in the '078 Patent is incapable maintaining a growth surface gradient at any value in the claimed range (i.e., 0–20°C), much less throughout the full scope of the claimed range (e.g., 0°C), even if it was possible to accurately measure all growth surface temperatures.

Upon information and belief, Plaintiffs discovered that significant experimentation beyond the technical details described in the '078 Patent and generally known in the art at the time of purported invention would be required to make equipment capable of maintaining a growth surface gradient at any point in the claimed range (i.e., 0–20°C), let alone throughout the full scope of the claimed range (e.g., 0°C), even if it was possible to accurately measure all growth surface temperatures.

Referring to claims 1 and 12, the '078 Patent does not teach how to measure “all” temperature gradients across the growth surface without undue experimentation.

In addition, the '078 Patent does not teach how to measure a growth surface temperature with a degree of accuracy sufficient to enable one of skill to control all temperature gradients across the growth surface to less than 20° C (e.g., 10° C, 5° C, 1° C, 0.1° C, 0.01° C, or 0.001° C) without undue experimentation. *See, e.g.*, Gray at 904; Sheldon at 5001; Bang at 175; Bieberich at 158S–160S and 165S; McCauley 1997 at 1861–1865; McCauley Dtn. at 74, 78–96, 123, 138; McGinnis at 22–24; Liang 2013 at 197; Regmi at 160–164; Nad Dtn. at 165 (different emissivity settings required for polycrystalline and monocrystalline diamond).



Respectfully submitted,

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**Exhibit B.1**

to

Fenix's First Supp. Prelim. Invalidity Contentions Under Local Patent Rule 7

'078 Claims	Saito (EP 0 879 904)
<b>1.[pre]</b> A method for diamond production, comprising:	"The present invention relates to a method... for producing single-crystalline diamond." Saito at 1:3–5.
<b>1.[A]</b> controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.; and	<p>"Maintaining... the temperature of the prime base material 60 at <math>1050 \pm 10^{\circ}\text{C}</math>... While abnormal growing parts 11 appear on four corners of the prime base material 60, the diamond grows with no abnormal growth on extensions of the {110} side surfaces 60b and 60c." Saito at 9:30–43.</p> <p>"Flat single-crystalline diamond... can be obtained." Saito at 10:8–9.</p> <p>"Whereby single-crystalline diamond can be stably grown on the surfaces of the base material for forming high-quality single-crystalline diamond." Saito at 2:49–51.</p> <p>"Regions including abnormal growth can be limited." Saito at 3:35–36.</p> <p>"The single-crystalline diamond is vapor-deposited on the major surface... of the... base material." Saito at 3:54–57.</p> <p>"Abnormal growing parts 11... and depressed parts 52 appear on four corners and upper corner portions of an upper surface respectively." Saito at 9:1–4.</p> <p>"Hardly cause abnormal growth." Saito at 3:34.</p> <p>At least FIGS. 1(b), 2(a), 2(b), 5(a), and 6(b) illustrate the fabricated diamond as defining a flat and uniform upper surface.</p>
<b>1.[B]</b> growing single-crystal diamond by microwave plasma chemical vapor deposition on the growth surface	<p>"In the microwave CVD apparatus shown in FIG. 10." Saito at 9:31.</p> <p>"Microwave CVD apparatus for homoepitaxially growing a diamond under a... preferential orientation growth condition." Saito at 8:49–51.</p>
<b>1.[C]</b> at a growth temperature in a	"Maintaining the pressure in the reaction vessel 7 at $140 \pm 5$ Torr and the temperature of the prime base material 60 at $1050 \pm 10^{\circ}\text{C}$ ." Saito at 9:10–34.

'078 Claims	Vohra (US 5,628,824)
<p><b>1.[pre]</b> A method for diamond production, comprising:</p>	<p>"This invention is a method for the production of monocrystalline diamond." Vohra at 2:67.</p> <p><i>Note: Vohra incorporates Yasui (US 5,292,371) by reference. Vohra at 9:27. Therefore, Vohra and Yasui can operate as a single prior art document.</i></p>
<p><b>1.[A]</b> controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.; and</p>	<p>"A preferred embodiment of this invention maintains the temperature of the substrate at above about 1600°C... It is postulated that the temperature is important to fine tuning the rates of the deposition of diamond versus the formation of nanocrystalline graphite." Vohra at 4:66–5:6.</p> <p>"The plasma region 32 heats the substrate 40 to a temperature in the desired range." Vohra at 5:57–58.</p> <p>"The position of the plasma... [is] adjusted to form a diamond... having a uniform quality and a uniform thickness on a substrate or base." Yasui at 2:57–60.</p> <p>"The diamond film grows on the surface of the substrate 40." Vohra at 5:66–67.</p> <p>"When a thin film of diamond... is synthesized by [microwave assisted] CVD... the base on which the thin film is to be formed have an ununiform distribution of temperatures. As a result, the quality of the diamond film... and the thickness of the diamond film become irregular." Yasui at 2:5–13.</p> <p>"The position of the plasma... [is] adjusted to form a diamond... having a uniform quality and a uniform thickness on a substrate or base." Yasui at 2:57–60.</p> <p>"Now a diamond film is uniformly deposited by way of vapor growth on the substrate 14." Yasui at 5:34–35.</p>
<p><b>1.[B]</b> growing single-crystal diamond by microwave plasma chemical vapor deposition on the growth surface</p>	<p>"This invention is a method for the production of monocrystalline diamond." Vohra at 2:67.</p> <p>"Although it is envisioned that the most useful way of generating a plasma will be by microwave radiation, other standard techniques for generating plasmas... may also be employed." Vohra at 3:39–44.</p> <p>"Monocrystalline diamond forms on the tip of the substrate." Yasui at 3:3–5.</p> <p>"This example describes the deposition of a thick homoepitaxial diamond layer on the (100) tip of a micro-cracked type Ia natural diamond anvil by MPCVD [microwave plasma chemical vapor deposition]." Vohra at 6:27–30.</p>

'078 Claims	Tsuno (US 5,474,021)
<b>1.[pre]</b> A method for diamond production, comprising:	“[T]echnique for providing a large diamond single crystal which can be used for a semiconductor material, an electronic component, an to optical component or the like.” Tsuno at 1:9–11.
<b>1.[A]</b> controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.; and	<p>“In an initial stage of epitaxial growth, abnormal growth tends to occur preferentially in side surfaces of a diamond substrate rather than at its principal surface. It is believed that this occurs because there is a high possibility that optimum growth conditions exist on the principal surface while conditions exist on side surfaces. When diamond plates are regularized in height, on the other hand, it is possible to suppress the non-epitaxial growth which is caused by regions having different growth conditions exposed in a vapor phase. Thus, it is possible to reduce the probability of abnormal growth generated in a boundary region between diamond plates.” Tsuno at 4:12–26.</p> <p>At least FIG. 6B illustrates a planar upper layer for grown diamond layer 32. See further, FIG. 13 (same for grown diamond layers 71, 72).</p> <p>“By visual observation, it seemed that transparent diamond was attained entirely over two {110} epitaxial films and the {100} epitaxial films grown at 1150° C., while black spots were partially observed on the remaining substrates... Table 3 shows linear transmittance values for visible light of 250 nm wavelength. The epitaxial film that was grown on the {100} substrate at 1150° C. exhibited the maximum transmittance value.” Tsuno at 11:30–47.</p> <p>“[I]nto an apparatus under 70 Torr pressure to heat the filaments, whereby the substrate temperatures reached constant levels of 950° C.” Tsuno at 12:1–3.</p> <p>“At this time, diamond was grown under of a pressure of 100 Torr and a plate temperature of 900° C.” “In the unpolished sample... steps of at most 40 [microns] were recognized.” Tsuno at 12:66–13:1.</p> <p>“This diamond plate 63 was maintained at a temperature of 1050 C.” Tsuno at 13:8–9. “The substrate temperature was maintained at 1000 C.” Tsuno at 13:46–47.</p> <p>“After polishing the cut surfaces, it was possible to obtain three transparent undoped diamond crystals 12 mm by 12 mm by 700 [microns] size.” Tsuno at 13:51–53.</p> <p>“It was proved from the results of the measurement that the inventive diamond is a large diamond of high quality.” Tsuno at 14:63–65. See further Tsuno at Table 5 (under col. 15).</p>

'078 Claims	Knowles (US 5,560,779)
<p><b>1.[pre]</b> A method for diamond production, comprising:</p>	<p>"There is provided a system for the manufacture of a diamond film." Knowles at abs:1–2.</p> <p>"A method for synthesizing diamond." Matsumoto at abs:1.</p> <p><i>Note: Knowles incorporates Matsumo (US 4,767,608) by reference. Knowles at 1:17. Therefore, Knowles and Matsumo can operate as a single prior art document.</i></p>
<p><b>1.[A]</b> controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.; and</p>	<p>"A low internal strain, high quality optical film is generated by depositing the carbon on a substrate supported by a heat sink having nonuniform thermal conductivity such that the thermal gradient across the surface of the heat sink is less than about 8 C./centimeter." Knowles at abs:11–15.</p> <p>"Preferably, the thermal gradient across the top plate 142 is less than about 8°C./centimeter and more preferably, less than about 4 C./centimeter." Knowles at 8:3–6. "The laminar flow pattern causes a temperature gradient to develop across the substrate 36. FIG. 12 illustrates graphically this temperature gradient. The substrate is hotter at the center than at the periphery. The temperature gradient is undesirable since it introduces strain into the developing diamond film. This strain can cause fracture of the film or inconsistent optical properties. By designing the substrate with a controlled, nonuniform cooling rate, the thermal gradient is reduced." Knowles at 7:42–51.</p> <p>"Due to the flow pattern of the plasma plume 148, the temperature of the top plate 142 is higher in the center 150 than the periphery 152. One way to minimize the thermal gradient is through thermally resistive gaps 154." Knowles at 7:61–64.</p> <p>"A high thermal capacity heat pipe ensures a minimal temperature gradient across the top plate 142." Knowles at 8:27–29.</p> <p>"Another advantage is by using the apparatus of the invention, a uniform, strain free diamond film is formed." Knowles at 1:64–66.</p> <p>"The substrate temperature and the precipitation zone temperature can be readily controlled to a uniform level." Matsumoto at 2:20–22.</p> <p>"Whereby the substrate temperature and the precipitation zone temperature can readily be controlled to a uniform temperature to obtain a film-form or bulk crystal-form diamond having uniform properties, or a fine powder-form diamond having a uniform particle size and properties." Matsumoto at 2:9–14.</p>

'078 Claims	Snail 976 (US 5,704,976)
<b>1.[pre]</b> A method for diamond production, comprising:	"A method for synthesizing large, single crystal diamond." Snail 967 at abs:1.
<b>1.[A]</b> controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.; and	<p>"The temperature of the substrate 11 may be adjusted by repositioning the substrate 11 along the Z axis." Snail 967 at 4:48–51.</p> <p>"Substrate 11 and the diamond seed crystal surface upon which the diamond is to be grown." Snail 967 at 6:60–61.</p> <p>"Any means of controlling the substrate temperature may be used... thereby increasing or decreasing the temperature of the substrate 11 and the diamond seed crystal brazed on the substrate 11." Snail 967 at 7:3–16.</p> <p>"During the one hour deposition, the substrate is maintained at 1300°C." Snail 967 at 8:60–61. "The diamond temperature generally will not deviate significantly from the substrate temperature." Snail 967 at 7:50–54.</p>
<b>1.[B]</b> growing single-crystal diamond by microwave plasma chemical vapor deposition on the growth surface	<p>"Other techniques of producing... plasma can be used according to the present invention, such as microwave torches and combinations of RF plasma torches... and microwave torches." Snail 967 at 9:26–30.</p> <p>"The present invention relates generally to... synthesis of large, single crystals... of diamond." Snail 967 at 1:12–14.</p> <p>"Substrate 11 and the diamond seed crystal surface upon which the diamond is to be grown." Snail 967 at 6:60–61.</p>
<b>1.[C]</b> at a growth temperature in a deposition chamber having an atmosphere	<p>"The growth temperature of the diamond growing surface is regulated to between about 1100 to about 1700°C." Snail 967 at 7:38–39.</p> <p>"Deposition is preferably performed in a chamber... at... atmospheric pressure [760 torr]" Snail 967 at 7:59–61.</p>

**Exhibit B.2**

to

Fenix's First Supp. Prelim. Invalidity Contentions Under Local Patent Rule 7



<p>diamond such that all temperature gradients across the growth surface are less than 20° C.; and</p>	<p>“[A] thick film of diamond 802 is deposited on the mandrel 100 by any known diamond deposition technique, such as CVD [chemical vapor deposition.” To achieve uniform deposition for the desired wafer size, uniform temperature gradients must be maintained.” Fellbaum at 8:10–14.</p> <p>“Non–uniformity... can lead to substantial temperature differences at the deposition surface, which, in turn, can degrade the uniformity and quality of the diamond film being deposited.” Patten at 2:32–35.</p> <p>“[Gas] can be injected in a controlled manner into passages 1432 to control thermal conductivity of the gap 1450 as a function of radial position. A spatial variation of the gap thermal conductivity may also be established by varying the thickness of the gap as a function of radial position. (In this regard, see also... [US] 5,551,983.)” Patten at 7:3–11.</p> <p>“The localized outer regions of the wafer tend to heat or cool faster than the localized center region. This leads to non–uniformities in temperature profile across the wafer.” Shooshtarian at 2:5–7.</p> <p>“By locally heating and/or cooling certain regions of a wafer, deviations in temperature can be corrected... so that a substantially uniform temperature profile results for the wafer.” Shooshtarian at 2:57–67.</p> <p>“The maximum temperature gradient in the temperature profile across the wafer should be less than about 1°C/cm at temperatures higher than about 700°C.” Shooshtarian at 11:64–67.</p> <p>“The distortion produced from a non–uniform temperature profile in the plane of the substrate produces a stress which is proportional to the temperature gradient and the elastic properties of the [diamond] film.” Gray at 904.</p> <p>“During [diamond] deposition... thermal stress [accrues] from temperature non–uniformity.” Gray at 904.</p> <p>“It is [] necessary to control temperature gradients during deposition.” Gray at 908.</p> <p>“The importance of substrate temperature in determining the quality, uniformity and growth rate of diamond films is now well recognized.” Penn State at abs:1–2.</p> <p>“Since the quality... of the diamond films [is] sensitive to temperature, a uniform surface temperature is crucial for the deposition of diamond films with uniform properties.” Penn State at 2.</p> <p>“[R]egulation of the substrate surface temperature becomes a more complicated problem. The filament geometry must be optimized to achieve uniform thermal radiation... [T]he substrate surface temperature must be controlled by a sophisticated cooling system or by precise balance of the heat radiation of the</p>
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filament to achieve the exact optimal substrate surface temperature... The substrate surface temperature is one of the most important deposition parameters.” Haubner at 1279.

“When scaling up the hot-filament method, a uniform temperature distribution and the gas flow become additional factors of major importance for obtaining good quality diamond coating.” Haubner at 1279.

“The infrared camera can detect differences of less than 3° C. for temperatures of up to 1,200 C. with a spatial resolution of better than 1/10 of an inch on a six inch diameter silicon wafer. In addition, color coded thermal maps of the wafer temperature can be stored at rates of many times per second and thus the wafer temperature uniformity can be monitored during rapid thermal ramps. With the use of a camera, it is possible to obtain temperature uniformity by simply manually adjusting the electrical power applied to each of the individual lamps.” Gronet at 6:12–22.

“These edge to center temperature differences create radial stresses in a wafer which if large enough, can damage the wafer, and are not tolerable in many processes, especially high temperature processes in which the mechanical strength of the wafer is substantially reduced. For example, at 1150° C. the center to edge temperature difference on a four inch silicon wafer of 50 approximately 5 C. can induce dislocation formation and slip.” Gronet at 1:42–52.

“[When growing diamonds,] Another disadvantage is the wide variation of substrate temperature, which may be greater than 150 C. over the surface of the substrate with the higher temperatures being observed near its center and the lower temperatures at its edges.” Kosky at 1:40–45.

“The principal purpose of thermal spreader 9 is to promote temperature uniformity over the entire surface of substrate 3. Heating means associated therewith, disclosed in detail hereinafter, may serve the further purpose of assisting in maintenance of the temperature of the substrate within the optimum range for diamond deposition.” Kosky at 3:58–65.

“Under diamond deposition conditions, the temperature difference across the substrate from corner to center was from about 775 to about 795 C., or only about 20 C. This is in contrast to the approximately 150° C. difference noted in the absence of the thermal spreader and thermal resistance unit. It was also noted, during the operation of said apparatus using a feedback temperature controller, that the temperature of the substrate fluctuated by only +/-2. C. when the power to the filaments was decreased from 5 to 3.2 kW.” Kosky at 5:34–45.

achieve different heating temperatures in order to either compensate for or substantially eliminate temperature variations throughout the substrate.” Mahawili at 2:40–66.

“In particular, by adjusting the heating effect of the different heater elements, temperature variations occurring diametrically across a substrate can readily be substantially eliminated or reduced to a satisfactory level” Mahawili at 3:54–59.

“Although the heater assembly of the present invention is thus described with three specific heater element segments, it will be apparent that any number of such segments could be employed as necessary for assuring uniform temperature control over the substrate 28.” Mahawili at 5:13–18.

“In any event, with the capability of sensing the output energy or temperature of each heater element segment or zone 22A-C, a temperature profile across a diametrical section of the heater can be electronically manipulated, in a manner well known to those skilled in the art, in order to achieve close regulation and minimum variation over the temperature profile. In any event, such controls permit the maintenance of a desired temperature profile under widely varying conditions of pressure and temperature in order to maintain a uniform temperature field within +2 C. across the substrate 28.” Mahawili at 5:49–59.

“The present invention relates to a synthetic diamond deposition for vapor-depositing a synthetic diamond crystal film on the surface of a metal substrate so that the temperature distribution on the surface of the substrate is made uniform” Kobayashi at [0001].

“Therefore, if there is a large variation in the temperature distribution between the central portion and the outer peripheral portion of the substrate, the diamond precipitation area is restricted, resulting in a phenomenon that the diamond conversion rate with respect to the raw material components decreases.” Kobayashi at [0005].

“The present invention is a further development of the above-mentioned prior art, and its purpose is to reduce the temperature gradient between the central portion and the outer peripheral portion of the substrate” Kobayashi at [0006].

“The condition of the ratio (D / T) of 40 or less means that a substrate having a wall thickness equal to or larger than a certain thickness is used with respect to the diameter. It functions to make the distribution uniform.” Kobayashi at [0008] and FIGS. 1–3.

Kobashi at FIGS. 1 and 4 (showing holder design that shields sides of growing diamond).